

# PROJECT facts

U.S. DEPARTMENT OF ENERGY  
NATIONAL ENERGY TECHNOLOGY LABORATORY

## Sequestration

10/2002

### PRIMARY PARTNER

Argonne National Laboratory

### DOE FUNDING PROFILE

DOE	\$ 569,000
Non-DOE	\$ 0

### TOTAL ESTIMATED COST

DOE	\$ 569,000
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## CO<sub>2</sub> CAPTURE FOR PC-BOILER USING FLUE-GAS RECIRCULATION: EVALUATION OF CO<sub>2</sub> CAPTURE/UTILIZATION/DISPOSAL OPTIONS

### Background

Concerns over possible global climate changes due to increasing atmospheric concentrations of greenhouse gases, such as carbon dioxide, have led to a strong emphasis on the development of high-efficiency, coal-based energy systems, incorporating the recovery of CO<sub>2</sub> for sequestration or use. One approach is the use of oxygen fired combustion with flue gas recycle to maintain a normal temperature profile in the furnace. The product directly leaving the boiler then is a CO<sub>2</sub>-rich stream that is ready for sequestration or use with only modest conditioning. Conditioning is required to dry the CO<sub>2</sub>, remove oxygen to prevent corrosion in the pipeline, and possibly other contaminants and diluents such as nitrogen, SO<sub>2</sub> and NOx.

The U.S. Department of Energy is investigating the feasibility of retrofitting boilers using this concept as a strategy for CO<sub>2</sub> recovery from conventional pulverized coal plants. This approach was conceived nearly twenty years ago at Argonne National Laboratory (ANL) as a low-cost CO<sub>2</sub> source for enhanced oil recovery (EOR). A molar ratio of CO<sub>2</sub>/O<sub>2</sub> of about 3 is necessary to preserve the heat transfer performance and gas path temperatures, allowing this system to be applied as a retrofit. ANL is studying all the engineering aspects of this system, including the effect of impurities, such as SO<sub>2</sub> and NOx, and CO<sub>2</sub> transportation, use, and options for long-term sequestration. If the flue gas can be recycled before SO<sub>2</sub> scrubbing, significant cost savings are possible.

This project will provide the power industry with a low-cost retrofit system that could remain in service during future upgrades at the power plant. The captured CO<sub>2</sub> can be used for EOR or sequestered. Overall, this project addresses both design and full energy-cycle issues pertaining to our current coal-fired power plants.

### Primary Project Goal

The goal of the project is to conduct comparative engineering assessments of technologies for the recovery, transportation, and utilization/disposal of CO<sub>2</sub> produced in high-efficiency, coal-based, energy systems. Coordinated evaluations will address CO<sub>2</sub> transportation, CO<sub>2</sub> use, and options for long-term sequestration. Commercially available CO<sub>2</sub> capture technologies will provide performance and economic baselines for comparing innovative CO<sub>2</sub> recovery technologies across the full energy-cycle.

### Objectives

- The major objective is to develop engineering evaluations for the recovery of CO<sub>2</sub> from pulverized-coal-fired power plants retrofitted for flue-gas recirculation and to reconcile and extend these studies across the full energy-cycle.
- Another object is to extend this analysis to identify plants that may be retrofit candidates considering the effects of different coals and the accessibility of a sequestration zone.

# CO<sub>2</sub> CAPTURE FOR PC-BOILER USING FLUE-GAS RECIRCULATION: EVALUATION OF CO<sub>2</sub> CAPTURE/UTILIZATION/DISPOSAL OPTIONS

## Accomplishments

An oxygen-blown KRW coal-gasification plant producing hydrogen, electricity, and supercritical CO<sub>2</sub> was studied in a full-energy cycle analysis extending from the coal mine to the final destination of the gaseous product streams to establish energy and cost comparisons against a Vision 21 facility.

A full energy-cycle was evaluated based on simulation of an O<sub>2</sub> blown PC boiler with CO<sub>2</sub> recovery and flue-gas recirculation that includes details of the stream compositions for the whole system.

A transport-reservoir injection simulation that can handle noncondensable and contaminate gases was validated.

A study that shows the cost-effectiveness for flue gas recirculation vs. monoethanolamine (MEA) scrubbing for CO<sub>2</sub> capture was completed.

It has been shown that CO<sub>2</sub> does not interfere with the scrubbing of SO<sub>2</sub> from a stream with a high concentration of CO<sub>2</sub>.

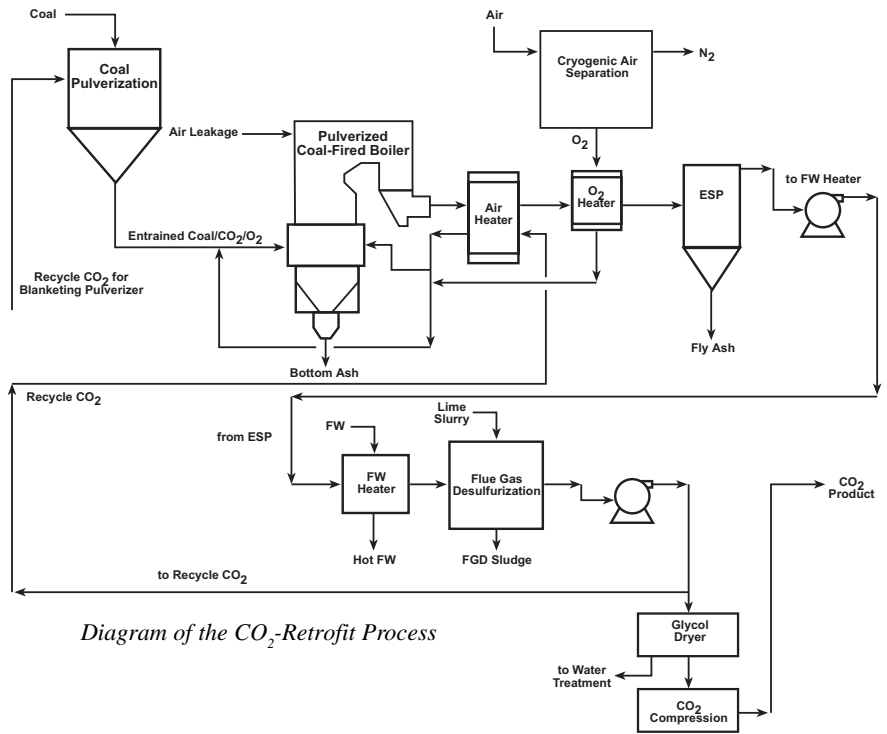
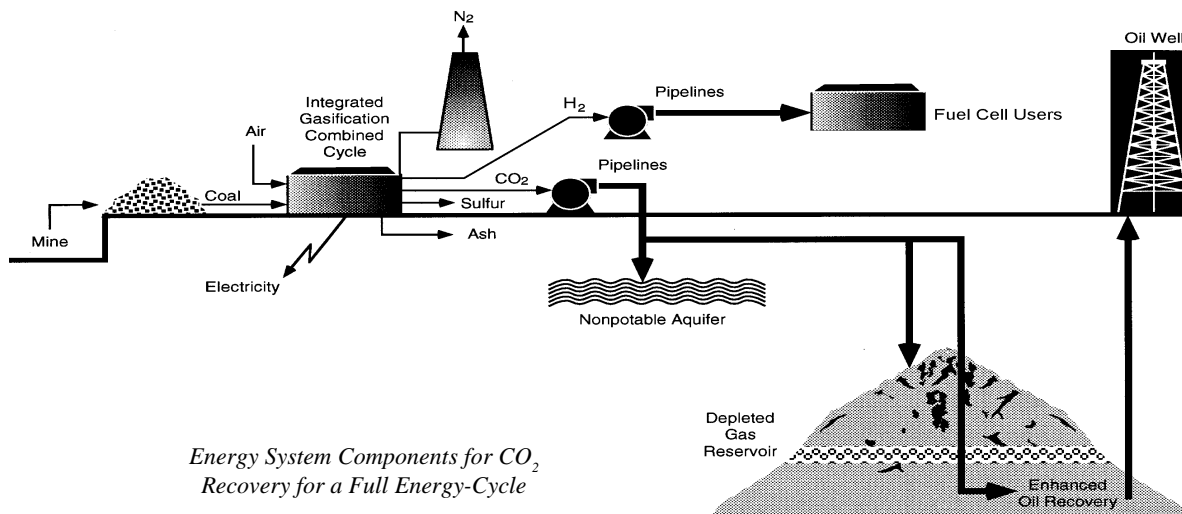


Diagram of the CO<sub>2</sub>-Retrofit Process

## Benefits

Pulverized coal plants are the most common type of power plant; therefore, a system that can be retrofit to such boilers and enable CO<sub>2</sub> recovery will have broad applicability. Flue gas recirculation eliminates the need for N<sub>2</sub>/CO<sub>2</sub> separation and sulfur separation, permitting more economical CO<sub>2</sub> recovery than competing amine systems. Technical and economic analyses will build on current accomplishments to develop a lower cost CO<sub>2</sub> capture technology.



Energy System Components for CO<sub>2</sub>  
Recovery for a Full Energy-Cycle